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Indian Standard

CRYSTALS AND DIELECTRIC MATERIALS USED IN INSTRUMENT INDUSTRY

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Indian Standard

CRYSTALS AND DIELECTRIC MATERIALS USED IN INSTRUMENT INDUSTRY

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 30 July 1973, after the draft finalized by the Optical and Mathematical Instruments Sectional Committee had been approved by the Mechanical Engineering Division Council.

0.2 This standard has been prepared with a view to facilitate comparison and selection of proper crystals for particular use in instrument industry. It gives the various physical, chemical and optical properties of crystals and dielectric materials.

1. SCOPE

1.1 This standard covers the optical, physical and chemical characteristics of crystals and dielectric materials (synthetic and natural) used in instrument industry (*see* Table 1).

TABLE 1 CRYSTALS AND DIELECTRIC MATERIALS USED IN INSTRUMENT INDUSTRY

(Clause 1.1)

Sl. No.	CRYSTAL	CHEMICAL FORMULA	MELTING POINT (°C)	SOLUBILITY IN COLD WATER (g/100 cm ³)	HARDNESS	OPTICAL PROPERTIES	APPLICATIONS
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Aluminium sesquioxide (corundum, ruby, sapphire alumina, emery)	Al ₂ O ₃	2050	0.000 098	9 Mohs	n _e = 1.759 to 1.763 birefringence weak	Grinding and polishing of optical surfaces and jewel bearings
2	Calcium carbonate (calcite calcspar, ice-land spar)	CaCO ₃	Sublimes at 898.6	0.001 4	3 Mohs	Doubly refracting, good transparency, high degree of polarization in a wide spectral range and transmits light between 0.22 and 2.7μ	Polarizing optics, double refracting prism and half shade polarizer
3	Calcium fluoride (fluorite, fluorspar)	CaF ₂	1 360	0.001 6	4 Mohs	Natural fluorite usually coloured	Transparent crystals are generally used with quartz for achromatic lens combination; as windows and prisms in ultra-violet, visible and infra-red spectroscopy; in telescope and microscope optical systems and apochromatic lenses and camera objectives

4	Caesium bromide	CsBr	—	124 at 25°C	19.5 kgf/mm ²	Refractive index 1.751 18 and 2.559 90 at 0.365 μ and 39.22 μ respectively and transmission range 0.210 μ to 50.0 μ	Window and prism material in infra-red spectroscopy
5	Caesium iodide	CsI	—	44 at 0°C and 160 at 61°C	—	Refractive index 1.987 04 and 1.619 25 at 0.297 μ and 53.12 μ respectively at 24°C and transmission range 0.235 μ to 60.0 μ	Window and prism material in infra-red spectroscopy
6	Lithium fluoride	LiF	870	0.27	136 kgf/mm ²	Refractive index 1.391 77 \pm 0.000 4 at wave-length 0.583 9 μ ; transmission range 0.110 to 6 μ ; dispersion range 1 to 5.9 μ in the infra-red and crystals grown in large sizes of high quality	Window and prism material in ultraviolet and infra-red spectroscopy; achromatic and apochromatic lenses especially with quartz
7	Potassium bromide	KBr	730	53.48	13 kgf/mm ²	Refractive index 1.571 81 at 0.486 μ at 20°C; spectral transmission range 0.21 to 27 μ ; infrared dispersion range 15 to 27 μ and crystals grown up to 190 mm diameter and 125 mm thick	Window and prism material for infra-red spectroscopy and achromatic lens combination
8	Potassium chloride (sylvine)	KCl	776	34.72	2 Mohs	Refractive index 1.490 443 at 0.589 32 μ at 15°C; transmission range 0.38 to 21.0 μ and grown in large sizes 190 mm diameter and 125 mm long	Window and prism material in ultraviolet and infra-red spectroscopy

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TABLE 1 CRYSTALS AND DIELECTRIC MATERIALS USED IN INSTRUMENT INDUSTRY — *Contd*

(Clause 1.1)

SL No.	CRYSTAL	CHEMICAL FORMULA	MELTING POINT (°C)	SOLUBILITY IN COLD WATER (g/100 cm ³)	HARDNESS	OPTICAL PROPERTIES	APPLICATIONS
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
9	Quartz (silica)	SiO ₂	1 470	Insoluble	7 Mohs	nd = 1.544; sp gr = 2.66; transmission range 0.18 to 3.5μ and not grown artificially	Ultraviolet optics; oscillator plates, lenses, slides and covers for fluorescent work; spectral prisms; reflecting prisms; Laurent's half shade plates for polarimeters, retardation plates; depolarizer; crystal for X-ray spectrography and wedges
10	Silver chloride	AgCl	455	0.000089	1.5-2 Mohs	Refractive index between 1 to 20.5μ vary from 2.022 39 to 1.901 49 at 23.9°C. May be used throughout the infra-red up to its practical transmission limit of 30μ. Grey or coloured not suitable for optical use; can be rolled into thin sheets and pressed into shapes, lenses, etc, and can be grown into crystals 95 mm diameter and 125 to 150 mm long	Window prism and absorption cell for use in the infra-red lens element for infra-red microscope objectives

11	Sodium chloride	NaCl	804	35.70	92 kgf/ mm ²	Refractive index of rock salt 1.544 313 at 0.589 32μ; transmission range 0.2 to 15μ; synthetic crystals are less hygroscopic than natural and crystals can be grown up to 190 mm diameter and 125 mm long	Ultraviolet, visible and infra-red spectroscopy infra-red microspectroscopy and lens element for ultraviolet and infra-red microscope objectives
12	Sodium nitrate (soda nitre, Chile-salt-petre)	NaNO ₃	308	73.0	1.5-2 Mohs	Birefringent; transmits light up to about 0.25μ and hygrographic	Replacement of calcite in polarizing optics
13	Sodium fluoride (villiaumite)	NaF	880	4.0	3.5 Mohs	—	—
14	Potassium iodide	KI	—	—	—	Refractive indices for F, D and C lines are 1.687 10, 1.666 60 and 1.658 40 respectively; transmission range 0.25 to 31μ and crystals up to 190 mm diameter and 125 mm long can be grown	Window and prism material for infra-red spectroscopy
15	Thallium bromide	TlBr	460	0.052 5	13 kgf/ mm ²	—	—
16	Thallium bromide and thallium iodide (KRS-5)	44% TlBr + 56% TlI	—	0.02	30 kgf/ mm ²	Refractive index 2.63; transmission 70 percent at 24.5μ; transmission range 0.5 to 40μ and practical infra-red dispersion range 24 to 40μ crystals of 125 mm diameter and 90 mm long can be used in open air	Window and prism material in infra-red spectroscopy; infra-red achromatic lenses and lens component microscope objectives

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TABLE 1 CRYSTALS AND DIELECTRIC MATERIALS USED IN INSTRUMENT INDUSTRY — *Contd*

Sl No.	CRYSTAL	CHEMICAL FORMULA	MELTING POINT (°C)	SOLUBILITY IN COLD WATER (g/100 cm ³)	HARDNESS	OPTICAL PROPERTIES	APPLICATIONS
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
17	Thallium chloride and thallium bromide (KRS-6)	60 % TlCl + 40 % TlBr	—	0.1	35 kgf/mm ²	Transmission up to 30 μ	Used where blue absorption of KRS-5 is troublesome
18	Muscovite	$\text{KAl}_2(\text{AlSi}_3\text{O}_{10})(\text{OH})_2$	625	—	2.5-4 Mohs	Strong birefringence	Retardation plates stepped wedges

NOTE — In addition to the above list, the following crystals have also been reported to be of utility in optical technology: Barium fluoride; strontium fluoride, cadmium fluoride, topa, magnesium aluminium oxide, grossularite, lead fluoride, zinc sulphide, diamond, potassium dihydrogen phosphate, titanium oxide, and ammonium dihydrogen phosphate.

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